

HIRUDINEA FROM THE INLÉ LAKE, S. SHAN STATES.

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(Text-figs. 1-7.)

The collection of leeches from the Inlé Lake, S. Shan States, kindly placed in my hands for study by Dr. N. Annandale, is a small one, comprising only three genera and five species. It is nevertheless of an exceptional interest on account of certain structural peculiarities exhibited by some of the new forms, which seem to throw considerable light upon the question concerning the external morphology of the Hirudinea in general.

One of the new forms, *Glossiphonia inleana*, sp. nov., is unique among the Glossiphonidae in having the three annuli constituting a somite easily recognizable at a glance. As is well known, the external annuli of the Hirudinea have, as a rule, an exactly similar appearance, making the determination of somite limits a matter of great difficulty. Until so late as 1900, when Castle (5) and Moore (11) almost simultaneously pointed out its inadequacy, an entirely erroneous method of plotting out the somite limits by assuming the sensillae-bearing annulus to be the first annulus of the somite, was in use among students of leeches. Now, in our species, there is no danger of being mistaken in the determination, as the furrows separating the somites are decidedly deeper and more conspicuous than those separating the annuli of the same somite. This is particularly apparent at the margins of the body, where the rings form groups of three each, two fused together and one separate, projecting toward the side in the form of broad and narrow teeth placed alternately.

Another new species, *Glossiphonia annandalei*, is also very interesting because of its having four of the six eyes arranged transversely upon one and the same annulus. This character, though not uncommon among the Herpobdellidae, has, so far as I know, never been observed in any of the remaining families.

The five species dealt with in the present paper are here systematically arranged:—

Family GLOSSIPHONIDAE.

Glossiphonia heteroclita (Linné).

Gl. inleana, sp. nov.

Gl. annandalei sp. nov.

Piobdella parasitica, juv. (?)

Family HERPOBELLIIDAE.

Trocheta quadrioculata, sp. nov.*Glossiphonia heteroclita* (Linné).Syn.: *Hirudo heteroclita*, Linné, 1761.*H. hyalina*, O. F. Müller, 1774.*H. trioculata*, Carena, 1823.*Clepsine hyalina*, Moquin-Tandon, 1826.*Glossiphonia heteroclita*, Moquin-Tandon, 1846.

Localities:—Loitan Tank, Yawnghwe Valley. One specimen.

Marginal zone, Inlé Lake. Three specimens, from *Pachylabra maura* (Reeve, Mollusca Gastropoda, family Ampullariidae).

These are all small specimens, measuring only 6 mm. in length and 3–4 mm. in width. Preserved in alcohol, the specimen from Loitan Tank is almost white; those from the other station are somewhat darker. In both cases there is no indication that the animal was striped or spotted during life.

The identification of these specimens is chiefly based upon the disposition of the six eyes, so characteristic of the species. They are arranged, namely, in three groups of two eyes each, one anterior median and two posterior lateral, in such a way that the animal, when examined superficially, appears to possess only three eyes. So far as I could ascertain, the constitution of the abbreviated somites at the anterior and posterior extremities of the body agrees fairly well with the minute description of American specimens of *Glossiphonia heteroclita* given by Castle (6).From *Glossiphonia ceylanica* Harding (9), some examples of which, according to Kaburaki (10), appear to be identical with this species, the specimens examined by me could be easily distinguished by comparing the position of the eyes. In *Gl. ceylanica* the second and third pairs of eyes are not so close together as in *Gl. heteroclita*, but are separated by at least one ring.*Glossiphonia inleana*, sp. nov.Locality:—Fort Stedman, Inlé Lake. Numerous (about 60) specimens, from a tortoise (*Cyclemys dhori shanensis* Annandale).*Shape and dimensions.* As shown in fig. 1 the form is rather slender for a *Glossiphonia*, being from 3 to 4 times as long as wide in moderately contracted specimens. The broadest part lies posterior to the middle, from where the body tapers very gradually toward both ends. Both the dorsal and ventral surfaces are convex, so that the body is somewhat lens-shaped in cross sections. The lateral margins are sharp and serrate. The posterior sucker is of moderate size, circular in outline. Except the shape of the head, which does not project toward the side, this species closely resembles *Hemiclepsis marginata*, with which it also shares the habit of living as an ectoparasite on tortoises.

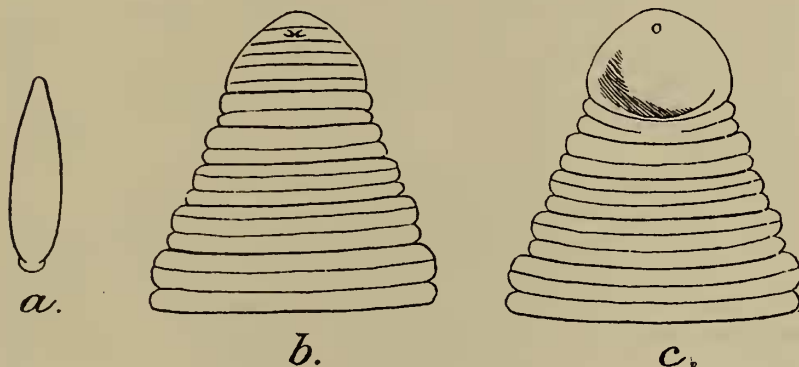
The largest individuals measure about 9 mm. in length and

nearly 3 mm. in width, the posterior sucker is about 1.5 mm. across.

External features. There is a single pair of eyes on the second annulus. They are pretty large and distinct, and are placed close together, almost touching with the base at the median plane of the animal. The opening of the pigment-cup is directed obliquely forward and toward the side.

The oral sucker occupies the ventral surface of the first six annuli, the ventral portion of annulus 6, which is very narrow on that side, forming the posterior boundary of the sucker. The mouth-opening is situated in the anterior half of the sucker just below the eyes, corresponding in position with annulus 2.

The genital apertures are separated by two rings; the male opening lies between annuli 26 and 27, the female opening between 28 and 29, counting each of those annuli at the anterior end,



TEXT-FIG. 1.—*Glossiphonia inleana*, sp. nov.

- a. Outline of entire animal: $\times 3$.
- b. Somites i-ix, dorsal view: $\times 30$.
- c. Somites i-ix, ventral view: $\times 30$.

which are double in larger specimens, as two. Both pores are small and inconspicuous. In most of the specimens the clitellum was not distinguishable from the rest of the body.

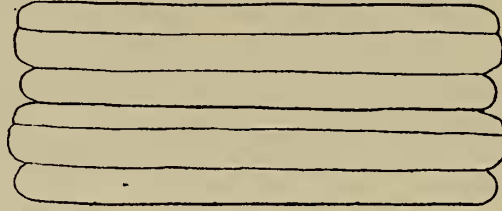
The anus is a small transverse slit placed behind the last annulus. There is, however, a small ring-like portion of the body on the dorsal surface of the sucker just behind the anus.

The hinder sucker is directed ventrally and is attached to the body by the ventral surface of the last three or four annuli.

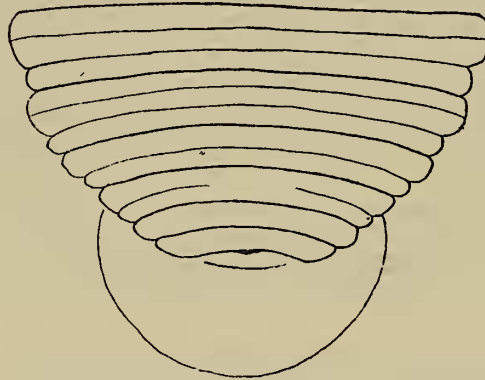
The specimens preserved in alcohol are of a uniform pale grey colour, but there are indications that the animal was ornamented during life with roundish spots regularly arranged on the dorsal surface, much in the same way as those of *Hemiclepsis marginala* (2). In many individuals the crop with its paired diverticula is recognizable externally on account of the dark brown mass (coagulated blood of the host) it contains.

Internal anatomy. The small mouth-opening leads into the

usual pharyngeal sac, in which is found the long muscular proboscis. This organ is rather slender throughout, being only about twice as thick at the base as at the tip. A pair of groups of unicellular salivary glands open into the posterior end of the proboscis. The oesophagus is quite short and leads into the crop, produced laterally into seven pairs of diverticula, of which the last is much larger than the rest and elongated posteriorly. The diverticula show a slight bifurcation laterally, except those of the



a.



b.

TEXT-FIG. 2.—*Glossiphonia inleana*, sp. nov.

a. Somites xvi and xvii : $\times 30$.

b. Somites xxii-xxvii, with sucker : $\times 30$.

last pair which have three metamerically arranged dilatations directed toward the side. The stomach is provided, as in all other species, with four pairs of simple finger-like caeca.

There are six pairs of testes placed alternately with the crop diverticula, the first pair occupying the space between the first and second pairs of the latter and partly covered by the second pair dorsally. The vas deferens forms a mass of convoluted tubes on either side of the male opening. The ovaries occupy the usual

position and present nothing particular compared with those of other well-known species.

Of the nephridia I counted sixteen pairs, which are situated in the same position as those of *Hemiclepsis marginata* (12). The openings could not be detected in surface views, so that their position had to be determined by a study of sections. They lie, as in many other species of the genus, in the furrow separating the first and second annuli of the respective somites.

The nervous system is composed of 34 ganglia connected by longitudinal nerve trunks. The first six are fused together to form the circum-oesophageal ring. The last seven are likewise coalesced in a single mass at the base of the hinder sucker. The remaining ganglia are separate, arranged regularly one in each somite, except near the anterior and posterior extremities where they are more crowded.

Annulation. As stated before, the somite limits are recognizable at a glance in this species, as the furrows separating the successive somites are more conspicuous than the interannular furrows. Examined under a low power of the microscope a little out of focus, the former alone are visible, while the latter disappear completely, in such a way that the worm has now the appearance of being uniannulate throughout. I have never seen a leech, except perhaps *Myxobdella annandalei* Oka (14) from Hongkong, which presented a somewhat similar appearance. Moreover, the interannular furrows are not all of the same depth, that separating the first and second annuli of each somite being always less deep than that separating the second and third annuli, so that in many somites the first two annuli appear as a single broad ring, especially at the margins. In most cases the three annuli composing a somite have different widths; as shown in the accompanying figure (fig. 2a) the second ring is the widest, then comes the third which is a little narrower, while the first ring is always the narrowest.

There is apparently a certain amount of variation in the constitution of somites at either end of the body according to the age of the individual. This will be clear from the following table which shows the annulation of two individuals, 9 mm. and 5 mm. in length respectively.

Somites.	Number of rings in each somite.			
			A.	B.
i, ii 1	1
iii, iv 2	1
v, vi 2	2
vii, viii 3	2
ix-xxii 3	3
xxiii 3	2
xxiv 2	2
xxv 2	1
xxvi, xxvii 1	1

Thus, the larger individual (A) has 67 rings, while the smaller one (B) has only 61. As the somites at the extremities are more abbreviated in younger individuals than in older ones, it is evident that the elaboration of the somites has progressed centrifugally from the middle region toward both extremities. This is exactly the opposite of what we should expect, if the triannulate somite represented the primitive condition, from which both biannulate and uniannulate somites were derived by subsequent abbreviation. An examination of the individual somites seems to confirm this view.

Somite i has only one ring. It bears a faint transverse groove which, however, does not reach to the lateral margins. Somite ii is clearly uniannulate, the pigment cup of the eye occupies almost the entire breadth of this ring. Somites iii and iv are biannulate in large individuals, but uniannulate in smaller ones. In the former case somite iii is composed of two rings of practically equal breadth, somite iv, on the contrary, of an anterior broader and a posterior narrower, the ratio of the breadths being about 2 to 1. Somites v and vi are always biannulate, being composed of a broad and a narrow ring. Somites vii and viii are triannulate or biannulate according to the size of the individuals, the furrow separating the first and second rings being confined to the median area in smaller individuals. Somites ix to xxii are triannulate. Somite xxiii is triannulate in large individuals but biannulate in small ones; in some cases it is difficult to decide whether the somite should be considered as triannulate or as biannulate. Somite xxiv is biannulate; somite xxv either bi- or uniannulate; somites xxvi and xxvii uniannulate. The biannulate somites at the posterior end of the body are invariably composed of an anterior broader and a posterior much narrower ring. At the margins all the triannulate somites appear as biannulate, as the rings 1 and 2 form a single broad tooth separated by a notch from the narrow tooth formed by the ring 3.

The chief peculiarity in the external morphology of this leech is, as already stated, that the somite boundaries are recognizable at a glance and the three annuli forming a somite are not of the same size. By tracing the somites from the extremities toward the median region, we can observe the various stages through which the primitive uniannulate somite of the ancestral leech gradually became the typical triannulate somite of the Glossiphonidae. First the somite became broader, then a narrow ring was separated off from the posterior margin. The biannulate somite thus formed next became triannulate by the separation of a still narrower ring from the anterior margin. Afterwards the three rings became equivalent in size, making it extremely difficult to find out where the somite boundaries really are.

This species presents a certain resemblance to the diagrammatic figure of *Placobdella emydae* Harding (9), with which it agrees in the number of crop diverticula, the testes, and the position of the genital openings. Both forms were also found attached

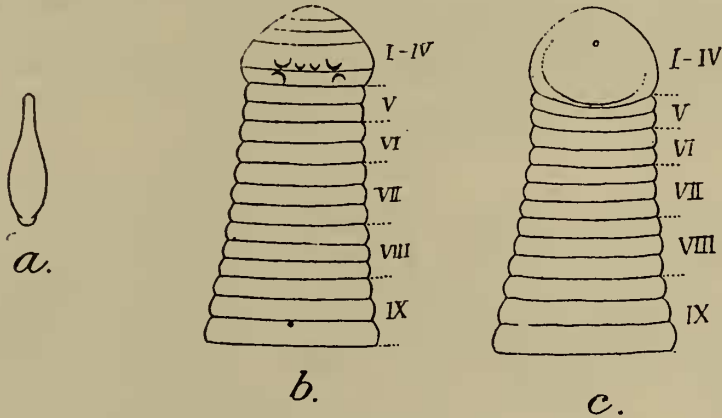
to chelonians. In reality, however, the difference is very great, as *Pl. emydae* is a broad and flat species, measuring 13.5 mm. in length by 9 mm. across.

***Glossiphonia annandalei*, sp. nov.**

Localities:—Central region of Inlé Lake. Eight specimens.

Central region of Inlé Lake. Two specimens, on *Taia intha* Annandale (Mollusca Gastropoda, family Viviparidae).

Shape and dimensions. Body rather long and slender, not unlike *Gl. stagnalis*, anterior portion having the appearance of a neck. The greatest width, which is about one-third of the length, lies at about one-third of the length from behind. The head is slightly broader than the neck. The body is not much flattened, being convex on both sides, though more so on the dorsal than on



TEXT-FIG. 3.—*Glossiphonia annandalei*, sp. nov.

- a. Outline of entire animal: $\times 3$.
- b. Somites i-ix, dorsal view: $\times 30$.
- c. Somites i-ix, ventral view: $\times 30$.

the ventral surface. The margins are sharp and serrate, but not thinned out. The hinder sucker is small and directed ventrally and backward.

The largest example, somewhat contracted, measures 6 mm. in length and 2.8 mm. in width.

External features. The surface of the body is on the whole smooth, all the papillae being low and insignificant. Neither transverse nor longitudinal rows of particularly large papillae could be observed.

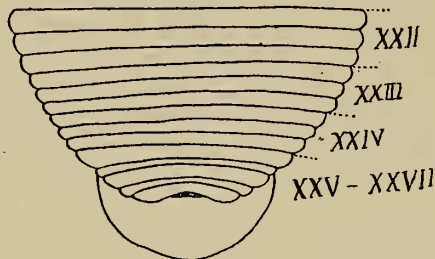
The oral sucker occupies the ventral surface of the first five rings, ring 5, which is very narrow on the ventral side, forming its posterior border. The small mouth-opening lies a little in front of the middle of the sucker.

There are three pairs of eyes, whose position is quite unique among the Glossiphonidae. Two pairs are situated in the pos-

terior half of annulus 4, a pair of small eyes on either side of the median line and a pair of much larger eyes placed about midway between the median eye and the lateral margin. The opening of the pigment-cup of the median eyes is directed forward, that of the lateral eyes forward and slightly toward the side. The remaining pair is found on annulus 5 just behind the lateral eyes of the preceding annulus. The pigment-cup of this pair is directed backward and a little laterally. The two lateral eyes of either side are placed so closely together, that their pigment cups touch each other with their bottom, presenting the form of X in surface views. Very possibly the eyes which appear to be placed in annulus 5 belong in reality to annulus 6, the pigment cup having been displaced forward. So far as I am aware, there is no Glossiphonid hitherto known which presents a similar arrangement of eyes.

The genital openings are separated by two rings. The male pore lies between annuli 24 and 25, the female pore between 26 and 27. Both openings are small and inconspicuous. The clitellum could not be distinguished in any of the specimens.

The nephridial pores were invisible in surface views. By a careful study of longitudinal sections I was enabled to locate them



TEXT-FIG. 4.—*Glossiphonia annandalei*, sp. nov.

Somites xxii-xxvii with sucker: $\times 30$.

at the usual position, namely, in the furrow separating the first and second annuli of the respective somites. In all sixteen pairs of nephridia were observed.

The anus is situated behind the last annulus on the dorsal surface of the sucker.

The colour of the specimens preserved in

alcohol is a uniform pale gray. There is no indication of the animal having been spotted or mottled during life.

Internal anatomy. The proboscis is very long and slender. A short oesophagus connects the base of the proboscis with the crop, which extends over six somites and is provided with as many pairs of diverticula. The latter are all simple except those of the last pair which extend backward and are provided with three short branches directed toward the side. The stomach bears four pairs of simple tubular diverticula, of which the first two pairs are directed forward, the last pair backward, while the third pair lies about at right angles to the long axis of the body.

There are six pairs of testes placed alternately with the crop diverticula, the first pair being in front of the most anterior of the latter. The ovaries are, as usual, a pair of simple sacs extending back along the sides of the ventral nerve chain.

The nervous system agrees most closely with that of *Glossiphonia stagnalis*.

Annulation. Somites i, ii, and iii are uniannulate. Somite iv is biannulate, consisting of an anterior broad and a posterior narrow ring; it is in the hinder half of the broad ring, i.e. ring 4, that the four anterior eyes are transversely arranged, while the remaining two eyes are imbedded in the interior of the next ring. Somites v and vi are biannulate, with the rings of practically equal breadth. Somites vii-xxiv are triannulate; here the rings are of the same breadth throughout, so that there is no distinction between the inter-somital and interannular furrows. Somites xxv and xxvi are biannulate with the anterior ring about twice as broad as the posterior. Somite xxvii has but one ring, behind which is placed the anus. At the posterior extremity, where the somites are abbreviated, the somite boundaries can be determined without difficulty, as it is always the first and second annuli that are fused.

This species can be easily distinguished from all other species of the genus by the peculiar arrangement of the eyes mentioned above.

Placobdella parasitica, juv. (?).

Syn.: *Hirudo parasitica*, Say, 1824.

Clepsine parasitica, Diesing, 1850.

Cl. plana, Whitman, 1891.

Locality:—Canal on W. side of Inlé Lake. One specimen, on *Taia shanensis* (Kobelt).

It is with much doubt that I assign this specimen to the above species. Judging from the size as well as from the condition of the genital pores, it is certainly immature, and it is difficult to ascertain whether the slight but obvious discrepancies existing between this specimen and typical *P. parasitica* are due to difference in age or to specific distinctness.

The specimen is a good deal contracted. The form is oval, much arched dorsally, concave ventrally. The head is curved downward, so that the eyes cannot be seen when the animal is viewed from above. The lateral margins are similarly inflexed. The total length measured along the curved dorsum is 5.5 mm., the transverse diameter 3 mm., the widest part being a little behind the middle of the body. The posterior sucker is circular and measures about 1 mm. across; its margins are inflexed.

There is a single pair of eyes in the anterior half of the third annulus. They are not so close together as in the normal specimens of *Placobdella parasitica*. As I could not study the unique specimen in sections, it was impossible to determine whether the eyes were really simple, as they appeared to be in surface view, and not composed of three eyes crowded together as is the case in that species.

The genital pores are separated by two rings. The male opening is situated in the furrow between rings 27 and 28, the

female opening between 29 and 30. They are both very small and hidden in the furrow, so that the specimen had to be strongly bent dorsally to make them discernible.

The nephridial pores could not be observed.

The annulation is practically the same as that given by Castle (6) for *Glossiphonia parasitica*. Somites i and ii are uniannulate, somites iii and iv biannulate, somites v-xxiv triannulate, somites xxv and xxvi biannulate, and somite xxvii uniannulate, giving the total of 71 rings. Castle regards somites xxv and xxvi as uniannulate each, which reduces the number of rings to 69, but as these somites were divided, in his specimens too, into a broad anterior and a narrow posterior portion at the margins, the difference is more apparent than real. The oral sucker occupies the ventral surface of somites i-iv. The anus lies just behind the last (71st) ring.

The surface is on the whole rather smooth; in this respect the specimen comes nearer to var. *plana* than to var. *rugosa*. The dorsal surface is covered with numerous papillae, but they are all exceedingly low, and there seems to be no regularity as to their arrangement. The colour is a uniform pale gray.

One striking peculiarity in this specimen is that, on the ventral surface, the furrow separating the first and second annuli of each somite is markedly less deep than the others, in consequence of which the body appears, when viewed from this side, to be composed of double and single annuli arranged alternately. This is one of the rare instances among the Hirudinae where the somite limits are externally recognizable at a glance. On the dorsal surface, however, all the furrows appear quite alike, rendering it impossible to distinguish the inter-somital from interannular furrows. A similar condition was also noticed by Castle in some of his specimens of *Placobdella parasitica*, in which the anterior two-thirds of a somite appeared at places like a single broad annulus, but this character seems to have been present in his case on the dorsal as well as on the ventral surface of the body and not confined to the latter as in the case of our specimen.

***Trocheta quadrioculata*, sp. nov.**

Localities:—Central region of Inlé Lake. "Colour blood-red."
One specimen.

Central region of Inlé Lake on muddy bottom, 9-12 ft. One specimen.

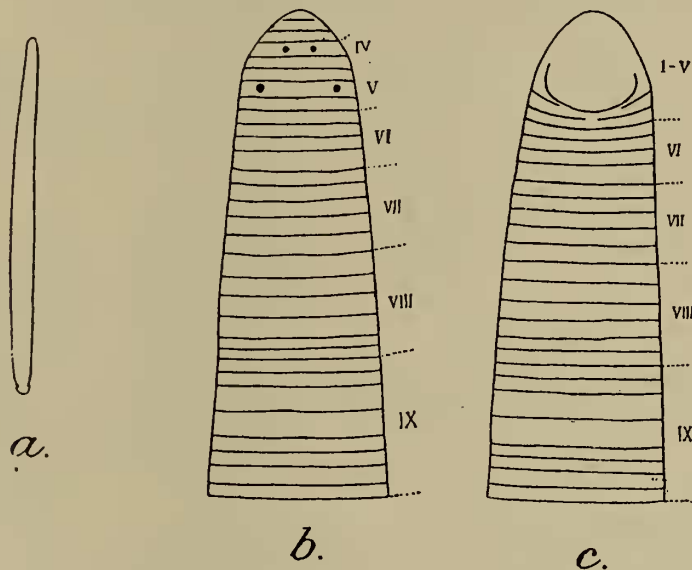
Shape and dimensions. Both specimens are small and seem to be immature. The body is long and slender, almost cylindrical, being only slightly wider in the middle than near the extremities. The head is rounded in front, forming the anterior lip of the spacious mouth. The hinder sucker is almost circular, a little broader than long, and is directed ventrally and backward.

The specimen from 9-12 ft. measures 24 mm. in length and

1.5 mm. in width; that from the first-named locality is 19 mm. in length and 1.3 mm. in width. The hinder sucker is about as wide as the body in both cases.

External features. The mouth is very wide and occupies the ventral surface of the first six rings. It is a spoon-shaped hollow directly continuous with the oesophagus. No jaws nor so-called pseudognaths are visible externally.

The eyes, in two pairs, are situated on the fourth and seventh rings, rather wide apart. In the individual from the first-named locality the posterior pair presents an anomaly in the fact that the right eye is placed one ring in front of the left eye, i.e.



TEXT-FIG. 5.—*Trocheta quadrioculata*, sp. nov.

a. Outline of entire animal: $\times 3$.

b. Somites i-ix, dorsal view: $\times 25$.

c. Somites i-ix, ventral view: $\times 25$.

on ring 6. There is no marked difference in size between the anterior and posterior pairs.

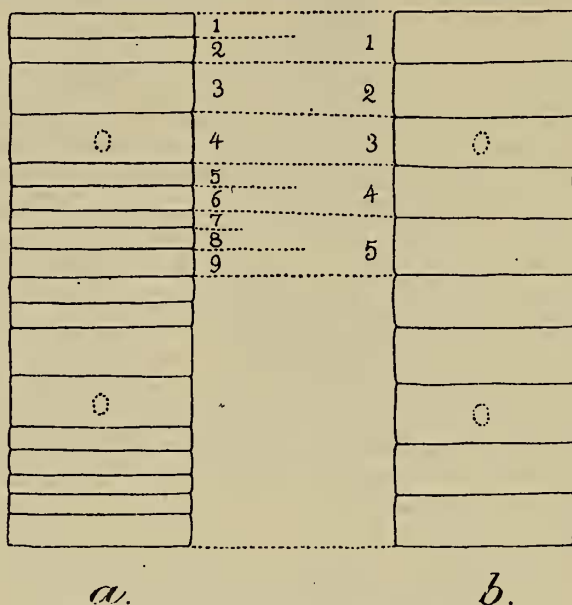
The genital apertures are very small, almost invisible, except the male opening of the smaller specimen which is rather prominent. The male pore is situated close to the posterior boundary of somite xi, the female pore just in front of the furrow separating ring 6 and ring 7 of somite xii; they are separated, thus, by a space equivalent to four rings of a five-ringed somite. The clitellum is not developed in either specimen.

The colour is pale grayish, a little yellowish anteriorly. There is no indication that the animal possessed any pattern during life. The surface is perfectly smooth all over.

As I have not studied the anatomy of the specimens, no

comparison can be made with allied forms in regard to the structure of internal organs. However, a minute study of the annulation of various similar-looking leeches from other sources has led me to the conclusion that the specimens under consideration can belong to no other genus than *Trocheta* Dutrochet.

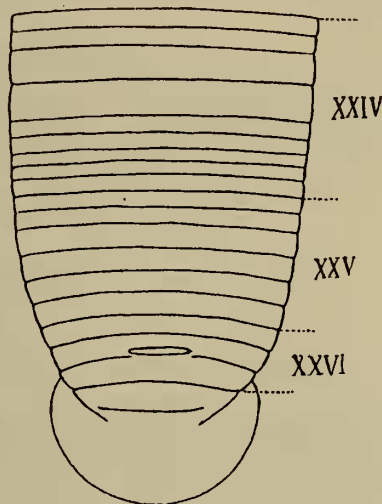
Annulation. The study of the annulation of this leech presented a very great difficulty. Observed in alcohol, the furrows were almost invisible, the integument appearing entirely smooth throughout the whole extent of the body. It was necessary, therefore, to examine the specimens placed on a piece of blotting paper and illuminated from the side, when the furrows became visible as faint lines on the half-dried surface.



TEXT-FIG. 6.—Somites xvi and xvii of
a. *Trocheta quadrioculata*, sp. nov.
b. *Herpobdella atomaria*.

The annuli are very numerous and of different widths. Except at the extremities they fall into groups repeated metamerically, each consisting of a definite number of broad and narrow rings. In the middle region of the body, we find two broad and seven narrow rings forming such a group, but where the somite limits exactly lie, it is impossible to tell for want of proper landmarks. A thorough investigation of those Herpobdellid genera, whose somites exhibit annuli of unequal widths, such as *Trocheta*, *Mimobdella*, and *Odontobdella* (as yet unpublished) enables me to state with certainty, that the somite limit falls between the fifth and sixth narrow rings. In other words, a somite in this species typically consists of nine annuli arranged in the following order: two narrow, two broad, and five narrow. Compared with the

five-ringed somite of *Hirudo* or *Herpobdella* (*Nephelis*) the first two rings of *Trocheta* correspond with the first ring of these leeches, the two broad rings with the second and third, the two narrow rings that come next with the fourth, and the last three narrow rings with the fifth. As shown in the accompanying figure, the narrow rings are not all of the same width, the seventh and eighth of each somite being always somewhat narrower than their neighbours either in front or behind. These rings have, in all probability, been derived by subsequent division from the anterior half of the last ring of a five-ringed somite and are, consequently, each equivalent to one-fourth of the original ring, while all the other narrow rings are each equivalent to one half of the original ring. In larger specimens of *Trocheta* from Japan these relations can be demonstrated so perfectly as to leave no doubt about the matter. The subject will be discussed more fully in my paper on the *Herpobdellidae* of Japan to be published shortly.



TEXT-FIG. 7.—*Trocheta quadrioculata*, sp. nov.
Somites xxiv-xxvii, with sucker: $\times 25$.

I refrain from giving the exact number of rings in these specimens, as it was impossible to count them in some places. On the whole, the annulation appears to be very similar to that of Japanese species of the same genus.

Remarks upon the genus *Scaptobdella* Blanchard.

In my Synopsis of Japanese Leeches (13) I recognized the genus *Scaptobdella* Blanchard and described a new species under the name of *Scaptobdella blanchardi*. Subsequent studies, however, led me to cast doubts upon the validity of this genus, which I now regard as synonymous with the European genus *Trocheta*. The reasons for this change will be given in my future paper referred to above. M. P. Gedroyé, in his paper on European leeches (7) expressed his doubts as to the systematic value of the genus *Scaptobdella*, and in his Synopsis of Polish Leeches (8) published some years afterwards, he abolished that genus and placed *Scaptobdella horsti*, the type of the genus, in the genus *Trocheta* naming it *Trocheta horsti*. In this regard I am of exactly the same opinion as the Polish author.

It may also be mentioned here that I possess a specimen of a small leech from Formosa, which agrees well with the specimens here described, in size, shape, annulation, and above all in the number and arrangement of the eyes. I regard it, therefore, as belonging to the same species. It is interesting to note that a new species of leech with characters different from those of any known form, has been discovered almost simultaneously from two localities so widely separated from each other as Burma and Formosa.

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